

## DOCUMENT RESUME

ED 334 023

PS 019 747

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TITLE Perinatal Sex Differences in Physiological and Behavioral Stress Reactivity.  
PUB DATE Apr 91  
NOTE 10p.; Paper presented at the Biennial Meeting of the Society for Research in Child Development (Seattle, WA, April 18-20, 1991).  
PUB TYPE Reports - Research/Technical (143)  
EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.  
DESCRIPTORS \*Birth; Heart Rate; \*Infant Behavior; Motor Reactions; \*Neonates; \*Perinatal Influences; \*Sex Differences; Socialization  
IDENTIFIERS Brazelton Neonatal Assessment Scale; \*Stress (Biological)

## ABSTRACT

This study examined physiological and behavioral stress reactivity in perinates in order to determine whether sex differences exist before extensive socialization. Fetal plasma cortisol response to the stress of labor and delivery, and neonatal heart rate and salivary cortisol response to a Brazelton Neonatal Assessment (NBAS), were measured. Male salivary cortisol was significantly higher at 10, 11, and 15 minutes post-NBAS than was female salivary cortisol. Female post-NBAS heart rate was higher than male heart rate, but the percentage change from baseline was not significant. The range of state cluster scores was higher in males, while motor performance was higher in females. (BC)

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**Perinatal Sex Differences in Physiological and Behavioral Stress Reactivity.** Maryann Davis,  
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**ABSTRACT.** Many studies have reported sex differences in stress reactions among children and adults. The present study examined physiological and behavioral stress reactivity in perinates to determine whether sexually dimorphic stress reactivity differences exist before extensive socialization. Fetal plasma cortisol response to the stress of labor and delivery, and neonatal heart rate and salivary cortisol response to a Brazelton Neonatal Assessment (NBAS) were measured in 18 male and 18 female, full term, healthy, infants. Cortisol was assayed from umbilical cord arterial blood samples and pre and post NBAS saliva samples. Heart rate was obtained from a heart rate monitor. Male salivary cortisol was significantly higher at 10, 11 and 15min. post NBAS than female cortisol. While female heart rate was higher post NBAS than male heart rate, the percent change from baseline was not significantly different between the sexes. Range of state cluster scores, which taps reactivity, was higher in males, while motor performance was higher in females.

#### SPECIFIC AIMS.

1. Demonstrate greater adrenocortical response to the stressful events of delivery and a behavioral exam in male perinates.
2. Demonstrate greater heart rate change in male than female neonates in response to a behavioral exam.
3. Determine whether males exhibit greater behavioral stress reactivity than females through their behavior on the NBAS.

#### METHODS.

**Subjects.** Subjects were 18 uncircumcised male and 18 female, full term (>37weeks), healthy neonates born at Crawford E. Long Hospital, Atlanta, GA. Fourteen male and 13 female infants were African American, 2 males and 4 females were caucasian, and 2 males and 1 female were of other ethnic heritages. All subjects underwent at least one hour of labor. One male and one female were cesarean section births, the remainder were vaginal deliveries. All subjects had Apgar scores >6 at 1min. and >7 at 5min. with the exception of 1 female who had a 1min. score of 4 but a 5min score of 9. All testing occurred between 24-60hrs of age.

#### Physiological Measures.

**Neonatal heart rate (HR)** was measured using a neonatal HR monitor that recorded either q-r-s waves or beats per minute. Adhesive electrodes and connections were attached 10min before NBAS. Connections were removed during, and reconnected immediately following NBAS (Figure 1). The number of beats during each of 6 10sec. intervals, beginning 4min into monitoring and immediately following NBAS, were used to calculate mean baseline and post test HR respectively.

**Serum cortisol** was radioimmunoassayed from fetal, arterial, umbilical cord blood routinely collected after delivery.

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Salivary cortisol was radioimmunoassayed from saliva samples collected 5min before NBAS (-5min), immediately following NBAS (+1min), 1min before adhesive chest electrode removal (+10min), immediately after electrode removal (+11min), and 5min after electrode removal (+15min)(Figure 2). Each 1cc sample was removed using an aspirator and a suction catheter which deposited saliva directly into test tubes. One drop of a 5% citric acid solution was placed on the infant's tongue before inserting the suction catheter. Saliva collection lasted 1.64min (mean $\pm$ 0.67 S.D.) per sample.

**Behavioral Measures.** The NBAS was administered by a trained examiner approximately 10min after attachment of chest electrodes and HR monitor connection and 5min after first saliva sample. Because saliva sampling stimulated infants, the habituation items were not administered. Reliability with observers was >85%. NBAS scores were summarized according to the 7-cluster method (Lester, Als & Brazelton, 1982).

## RESULTS

There were no sex differences in demographic variables related to infant health or labor stress (Table 1). There were no significant sex differences in plasma cortisol at birth or in baseline HR (Table 1). Females had higher post NBAS HR, although the percent change from baseline HR was not significantly different between sexes (Table 1). The sex difference in post NBAS HR became a trend when baseline HR was covaried (ANOVA by sex,  $F(1,23)=3.44$ ,  $p<.08$ ).

Male cortisol response to NBAS and handling was significantly different from female response (Figure 3). Males had significantly higher cortisol than females at 10, 11 and 15min post NBAS. These differences held when baseline cortisol was covaried (Figure 3).

Males also scored significantly higher than females on the range of state cluster (Figure 4). Items in this cluster consist of peak of excitement, rapidity of buildup, irritability and lability of states. Females scored significantly higher on the motor performance cluster, which consists of general tonus, motor maturity, pull-to-sit, defensive movements and activity level (Figure 4).

## CONCLUSIONS

1. Males exhibit greater adrenocortical responses to some forms of stress at birth.
2. Males also exhibit greater behavioral stress reactivity at birth.
3. These results are consistent with findings of greater stress reactivity in children and adults and suggest some biological basis to this difference.

**Table 1.**

| <b>Demographic Variables</b>                    |                              |                                |          |           |             |
|-------------------------------------------------|------------------------------|--------------------------------|----------|-----------|-------------|
| <i>Variable</i>                                 | <i>Males<br/>(Mean+S.D.)</i> | <i>Females<br/>(Mean+S.D.)</i> | <i>t</i> | <i>p=</i> | <i>d.f.</i> |
| <b>Birth Weight</b><br>(grams)                  | 3352.61+485.84               | 3341.00+426.99                 | .08      | >.10      | 34          |
| <b>Birth Length</b><br>(inches)                 | 19.64+.96                    | 19.67+.69                      | -.10     | >.10      | 34          |
| <b>Apgar 1Min.</b><br>(range=4-7)               | 7.89+1.07                    | 7.94+1.10                      | -.15     | >.10      | 34          |
| <b>Apgar 5Min.</b><br>(range=8-9)               | 8.89+.32                     | 8.94+.24                       | -.59     | >.10      | 34          |
| <b>Duration of Labor</b><br>(hours)             | 10.15+7.04                   | 8.81+6.48                      | .58      | >.10      | 32          |
| <b>Maternal Age</b><br>(years)<br>(range=18-40) | 26.56+5.08                   | 27.5+6.14                      | -.50     | >.10      | 34          |
| <b>Previous Live Births</b>                     | 2.28+.96                     | 2.33+1.09                      | -.16     | >.10      | 34          |

### **Physiological Stress Reactivity Measures**

|                                                    |              |                        |       |       |    |
|----------------------------------------------------|--------------|------------------------|-------|-------|----|
| <b>Umbilical Cord Serum Cortisol</b><br>(mg/dL)    | 15.57+5.26   | 15.26+7.25             | .15   | >.10  | 33 |
| <b>Baseline Heart Rate</b> (bpm mm Hg)<br>(n=14)   | 143.40+15.87 | 146.90+19.41<br>(n=16) | -.53  | >.10  | 28 |
| <b>Post Test Heart Rate</b> (bpm mm Hg)<br>(n=11)  | 139.65+15.83 | 153.73+17.53<br>(n=14) | -2.08 | <.05* | 23 |
| <b>% Heart Rate Change from Baseline</b><br>(n=10) | 0.93+15.20   | 8.90+14.00<br>(n=14)   | -1.33 | >.10  | 22 |

### Figure Legends

- Figure 1. Time course of HR, saliva and behavioral sampling during neonatal observations.
- Figure 2. Suction catheter placement in mouth of neonate for lcc saliva sample removal for cortisol assay. A drop of 5% citric acid solution was placed on the tongue prior to catheter insertion.
- Figure 3. Mean ( $\pm$ S.D.) salivary cortisol levels (mg/DL) among healthy, full term male and female infants at 24-60hrs of age, taken before and after NBAS administration. Sex differences were significant 10,11 and 15min post NBAS ( $t$ =(df); -5min, .15 (30),  $p>.10$ ; +1min, 1.13 (27),  $p>.10$ ; +10min, 2.32 (29),  $p<.03$ ; +11min, 3.04 (27),  $p=.005$ ; +15min, 2.46 (29),  $p=.020$ ). Covarying baseline salivary cortisol produced the same results (ANOVA for sex  $F$ (df)=; +1min, 2.74(1,30),  $p>.10$ ; +10min, 7.22(1,28),  $p<.02$ ; +11min, 9.37(1,27),  $p<.01$ ; +15min, 7.11(1,29),  $p<.025$ ).
- Figure 4. Mean cluster score ( $\pm$ S.D.) for NBAS items administered to healthy, full term neonates 24-60hrs after birth. Males scored significantly higher than females on the range of state cluster ( $t=2.13$ ,  $df=34$ ,  $p<.05$ ). Females scored significantly higher than males on the motor performance cluster ( $t=2.92$ ,  $df=34$ ,  $p<.01$ ).

**Figure 1.**

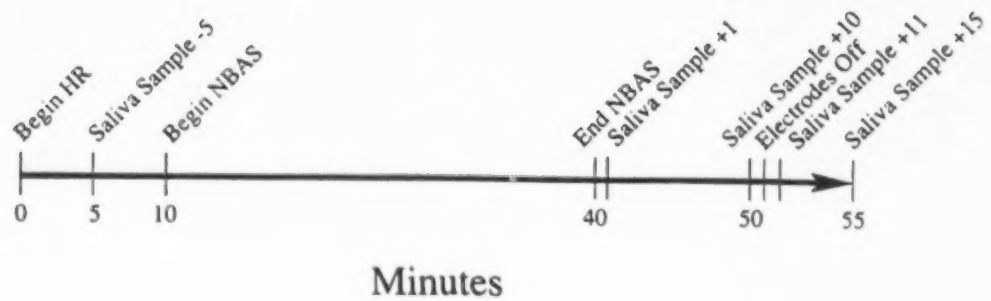
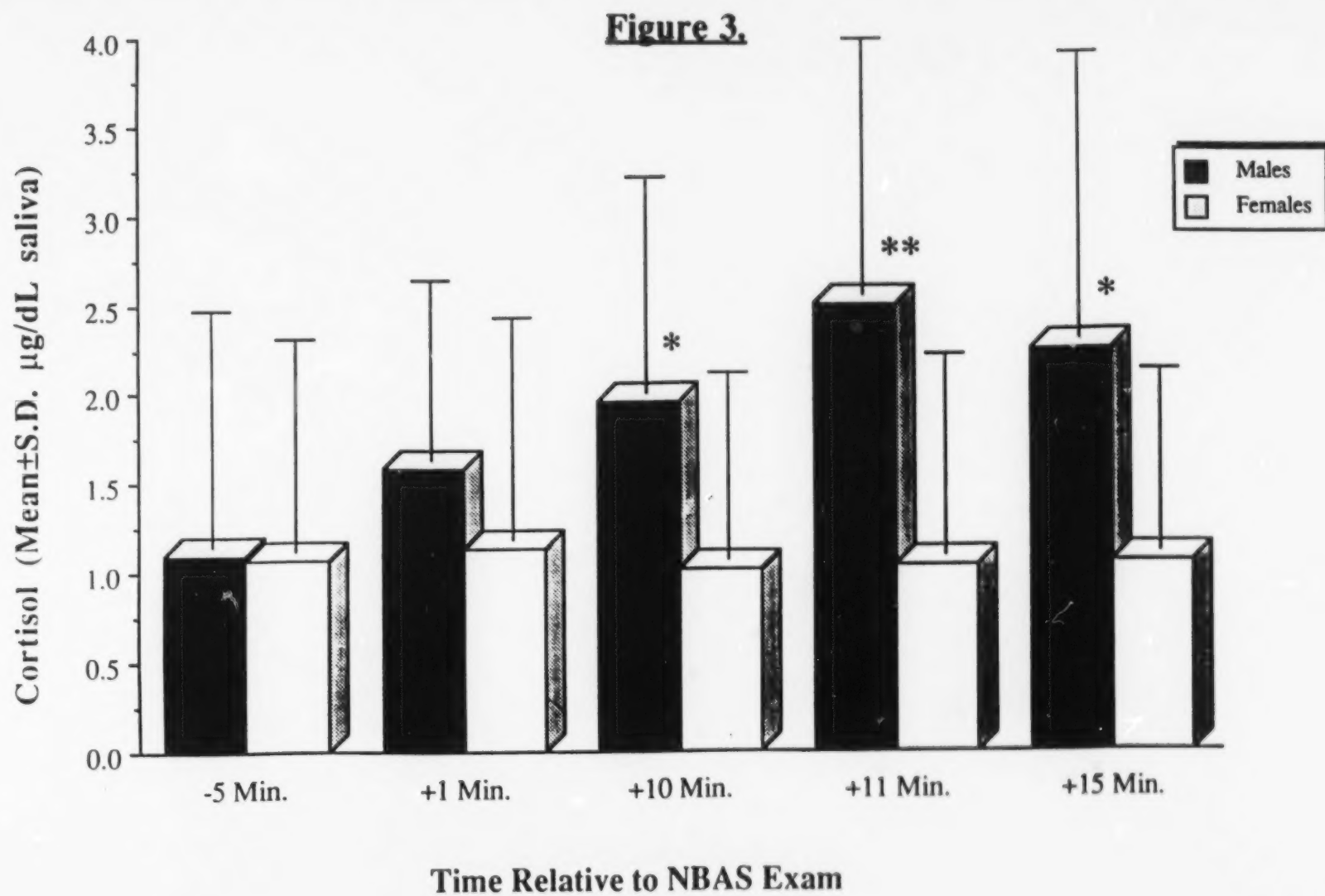


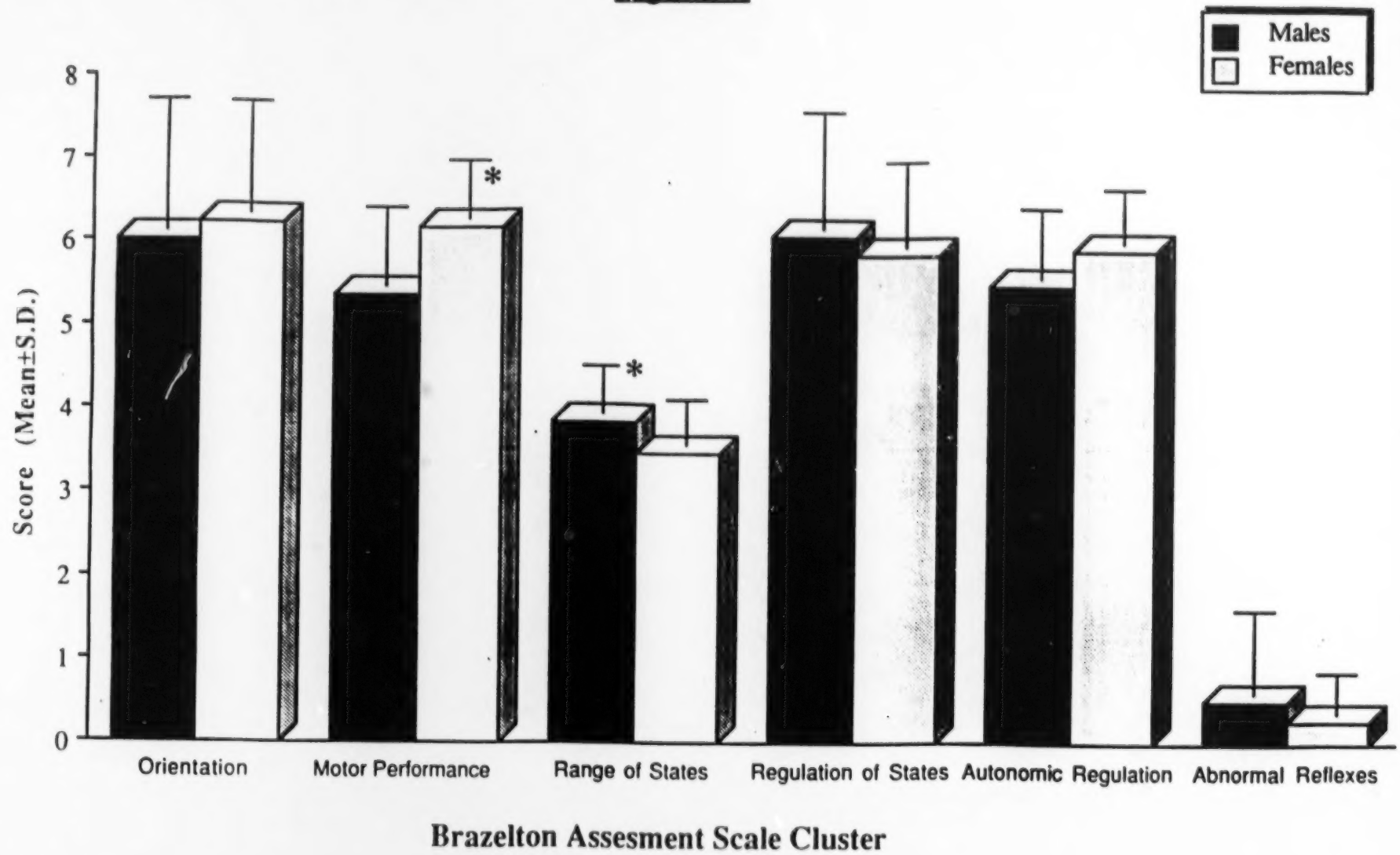
**Figure 2.**





Significant sex difference (t-test \*= $p < .03$  \*\*= $p = .005$ )

**Figure 4.**



\* Sex difference (ttest  $p < .05$ )